⑲日本国特許庁（JP）　⑪特許出願公開

⑫公開特許公報（A）　昭60－105802

⑤1Int.Cl.⁴　識別記号　庁内整理番号　⑬公開　昭和60年(1985)6月11日
F 22 B 1/20　8313－3L

審査請求　未請求　発明の数 1　（全5頁）

⑤4発明の名称　ソーダ回収ボイラ

⑳特　願　昭58－212583
㉒出　願　昭58(1983)11月14日

㉗発明者　浦方　久隆　長崎市飽の浦町1番1号　三菱重工業株式会社長崎造船所内
㉑出願人　三菱重工業株式会社　東京都千代田区丸の内2丁目5番1号
㉔復代理人　弁理士　木村　正巳

明　細　書

1.発明の名称

ソーダ回収ボイラ

2.特許請求の範囲

ソーダ回収ボイラの節炭器または別の場所にボイラで発生した蒸気またはボイラ水を導いて形成される蒸気冷却壁または水冷壁で囲まれ、かつ黒液燃焼ガスから隔離された燃焼室を設け、その燃焼室に油またはガスバーナを装備し、燃焼室出口部に高温過熱器を配置し、その高温過熱器に黒液燃焼ガスによつて過熱された蒸気を導くことにより、過熱器管を異常に腐食させる心配のない油またはガスの燃焼熱でさらに高温の過熱蒸気をつくり出すようにしたことを特徴とするソーダ回収ボイラ。

3.発明の詳細な説明

この発明は、特に製紙工場に設備されるソーダ回収ボイラに関する。

製紙工場に設備されるソーダ回収ボイラには、パルプ製造過程で発生する廃液すなわち黒液を燃料として使用するが、前記黒液の中にパルプ製造過程で使用する薬品が多量に含まれているために、該黒液の燃焼生成ガスおよび該ガス中の灰分に腐食性成分を多量の含有してボイラの運転中にボイラチューブを激しく腐食させている。前述の腐食は、チューブのメタル温度が高い程著しく、特にボイラ中で最もメタル温度が高い過熱器管に顕著に発生する。

いま、従来の黒液を燃料とするソーダ回収ボイラの代表例について説明すると、第1図において、節炭器（a）で加熱されたボイラ給水は節炭器出口連絡管（b）によつて蒸気ドラム（c）に導かれ、該ドラム内の水はボイラ水管（d）を経て下降して水ドラム（e）に入り、ついで該水ドラム内の水の一部は前記ボイラ水管を通つて上昇して気水混合物になり、再び前記蒸気ドラムに入るが、他の水はすべて下降管（f）によつて火炉下部管寄せ（g）に導かれ、該火炉下部管寄せの水は火炉（h）からの熱を受けながら火炉蒸発管（n）を通つて上昇して気水混合物となり、ついで前記蒸気ドラムに導かれる。

この気水混合物は該蒸気ドラム内の気水分離装置によつて蒸気および水に分離されるが、該蒸気だけが飽和蒸気連絡管（ｏ）によつて後述する過熱器に導かれ、そのスクリーン過熱器（ｐ）、一次過熱器（ｑ）、二次過熱器（ｒ）、三次過熱器（ｓ）および四次過熱器（ｔ）を経由して順次蒸気温度が上昇し、前記四次過熱器の出口において規定温度に達した蒸気が主蒸気管（ｕ）によつてタービンに導入される。

なお、黒液の燃焼について説明すれば、黒液バーナ（ｉ）によつて炉内に噴射された黒液は炉底部にチャーベッド（ｊ）として堆積され、そこに一次空気ノズル（ｋ）および三次空気ノズル（ｌ）から全体の８０～９０％の空気が噴射されて燃焼が行なわれ、さらに上部の二次空気ノズル（ｍ）から残りの１０～２０％の空気が噴射されて燃焼ガス中の未燃物が完全に燃焼されることによつて行なわれるが、火炉を出た高温の燃焼ガスは、第１図に示した矢印方向に流れて、前記スクリーン過熱器、一次過熱器、二次過熱器、三次過熱器、四次過熱器、ボイラ水管および節炭器と熱交換を行ないながら、ガス温度が低下してボイラ出口ダクト（ｖ）に到達するものである。

しかるに、前述した従来ソーダ回収ボイラにおいては、既述した腐食現象を抑制するために過熱器の出口の蒸気温度を４５０～５００℃以下になるように制限しているが、近年の省資源、省エネルギの見地からプラント効率の向上が強く要望され、そのためにボイラの高温高圧化が避けられない状況にあり、しかし、前記以上の蒸気温度を高くすると、腐食が一層激しくなり、腐食して減肉した過熱器管の交換のためにボイラを頻繁に停止する必要が生じて製紙工場の操業に多大な悪影響を与えるという問題がある。

この発明は、このような現状からなされたものであつて、腐食のおそれがない温度域まで黒液燃焼ガスによつて蒸気を過熱してから、該蒸気を高温過熱器に導いて黒液燃焼ガスに比較して腐食性の低い油またはガスの燃焼ガスによつてさらに高温に過熱させることによつて従来ボイラの欠点を除去したソーダ回収ボイラを提供することを目的としている。

つぎに、この発明の実施例について図面によつて説明すれば、第２図において、火炉（ｈ）の上部をウエルデッドウオール構造の水冷壁である隔壁蒸発管（３）によつて仕切つて、油またはガス燃焼室（１２）を配設し、蒸気温度を規定値に上昇させるに必要な極く小容量の油またはガスバーナ（６）を装備させ、前記燃焼室の出口部には高温過熱器（９）を配置して黒液によつて４００～５００℃に過熱した蒸気を導入させ、前記高温過熱器において該蒸気をより高温の規定温度まで上昇させるものであるが、前記蒸気、水および燃焼ガスの流れについて詳述すると、水ドラム（ｇ）からボイラ水の一部が分配管（１）によつて隔壁入口管寄せ（２）に導かれ、隔壁蒸発管（３）を通つて熱を受けながら上昇して気水混合物となつて隔壁出口管寄せ（４）に入り、さらに隔壁上昇管（５）によつて蒸気ドラム（ｇ）に入る。

それから、前記蒸気ドラムからの飽和蒸気は、飽和蒸気連絡管（ｏ）によつて一次過熱器（ｑ）に導かれ、ついで二次過熱器（ｒ）、三次過熱器（ｓ）を通つて順次に黒液燃焼ガスによつて過熱されて４００～５００℃に達したところで、高温過熱器入口連絡管（７）によつて高温過熱器入口管寄せ（８）に導かれ、前記油またはガス燃焼室の上部に配置している前記高温過熱器によつてより高温の規定温度まで過熱した後に、高温過熱器出口管寄せ（１０）に入つて主蒸気管（１１）によつてタービンに導かれる。

前記油またはガス燃焼室には油またはガスバーナ（６）から燃料および空気が同時に噴射されて燃焼が行なわれるが、燃焼ガスは前記隔壁蒸発管および高温過熱器と熱交換を行ないながら第２図に示す矢印方向に流れて前記隔壁蒸発管の上部（スクリーン部）を通過したところで黒液燃焼ガスと合流する。

なお、前記油またはガス燃焼室を構成する隔壁蒸発管（３）からなる水冷壁の一部には耐火材（１３）で施工して、その部分での熱吸収を少なく

し、前記油またはガスバーナによつて発生した熱を効力有効に前記高温過熱器に与えるようにしている。

次に、この発明の他の実施例を第3図について説明すると、蒸気ドラム（c）から導いた飽和蒸気によつて冷却される蒸気冷却壁管（23）で囲壁を張られた油またはガス燃焼室（24）を配設し、該燃焼室に蒸気温度を上昇させるに必要な数く小容量の油またはガスバーナ（25）を装備するとともに、その上部に高温過熱器（30）ならびに再熱器（35）を配置し、黒液燃焼によつて４００～５００℃に過熱した蒸気を前記高温過熱器に導いてより高温の規定温度に上昇させるとともに、高圧タービンからの蒸気を前記再熱器によつて再び過熱させて低圧タービンに送るものであるが、前記蒸気および燃焼ガスの流れについて詳述すると、蒸気ドラム（c）から飽和蒸気が飽和蒸気連絡管（27）によつて蒸気冷却壁入口管寄せ（22）に導かれて前記蒸気冷却壁管を通り、熱を受けながら上昇して蒸気冷却壁出口管寄せ（26）に入り、さらに一次過熱器入口連絡管（29）によつて一次過熱器（g）に導かれ、ついで二次過熱器（f）および三次過熱器（e）を通つて順次黒液燃焼ガスによつて過熱され、蒸気温度が４００～５００℃に達した時点で高温過熱器入口連絡管（28）によつて高温過熱器入口管寄せ（29）に導かれて前記油またはガス燃焼室の上部の高温過熱器（30）によつてより高温の規定温度まで過熱した後に、高温過熱器出口管寄せ（31）に入つて主蒸気管（32）を経て高圧タービンに導かれる。

前記タービンを出た蒸気は、高温再熱蒸気管（33）によつて再熱器入口管寄せ（34）に導かれて再熱器（35）によつて再び高温に過熱し、ついで再熱器出口管寄せ（36）に入つて高温再熱蒸気管（37）を経て低圧タービンに導かれる。

前記油またはガス燃焼室には油またはガスバーナ（25）から燃料および空気が同時に噴射されて燃焼が行なわれるが、燃焼ガスは前記蒸気冷却壁管、高温過熱器および再熱器と熱交換を行ないながら、第3図に示す矢印方向に流れて、上部のスクリーンを通過したところで黒液燃焼ガスと合流する。

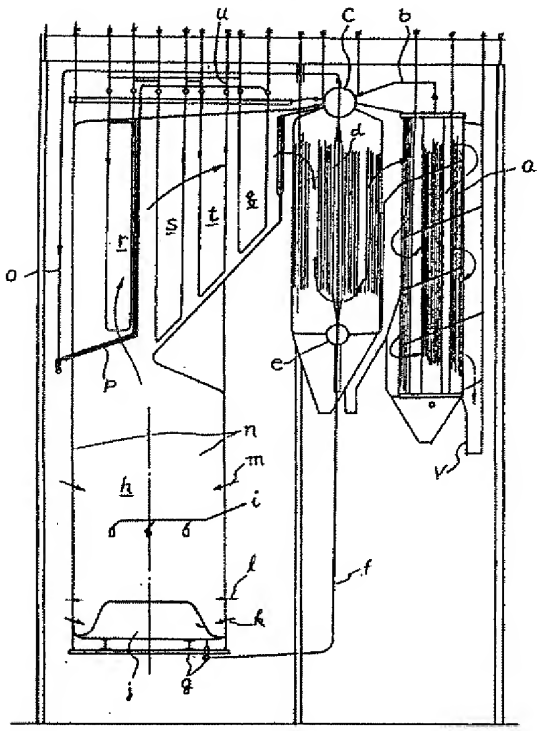
したがつて、この発明によれば、腐食のおそれのない温度域までを黒液燃焼ガスによつて蒸気を過熱してから、該蒸気を高温過熱器に導いて黒液燃焼ガスに比較して腐食性の低い油またはガスの燃焼ガスによつてさらに高温に過熱させることができるため、過熱器出口の蒸気温度を通常の発電プラントと場合と殆ど同様な５４０～５７０℃まで上昇させられ、また、さらに再熱器を装備することによつて大幅なプラント効率の向上が実現できる上に、黒液燃焼ガスによる蒸気温度の上昇を腐食のおそれがない温度域までに抑制させているから、従来のように腐食のための減肉に基因する過熱器管の交換が殆んど不要となり、製紙工場における操業度を格段に向上させることができるなど、この発明の産業上の利用価値には極めて大なるものがある。

4 図面の簡単な説明

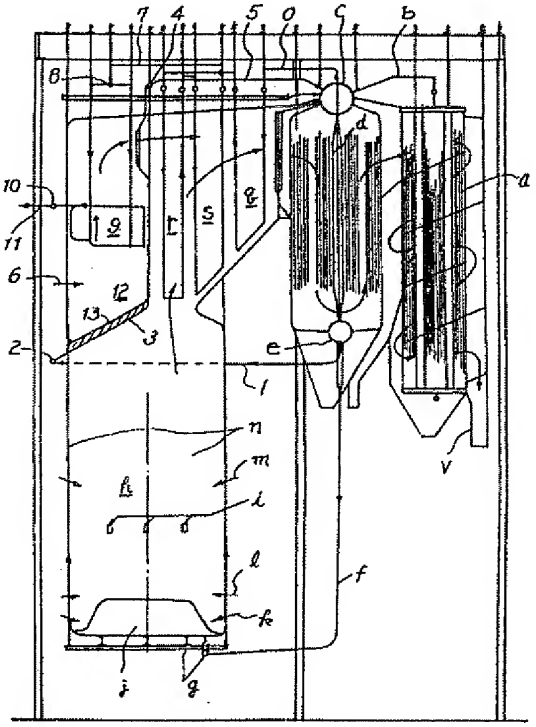
第1図は従来のソーダ回収ボイラの縦断側面図、第2図はこの発明の実施例を示す縦断側面図、第3図は同じく他の実施例を示す縦断側面図である。

（b）・・火炉、（i）・・黒液バーナ、（3）・・隔壁蒸発管、（6）・・油またはガスバーナ、（9）・・高温過熱器、（12）・・油またはガス燃焼室、（23）・・蒸気冷却壁管、（24）・・油またはガス燃焼室、（25）・・油またはガスバーナ、（30）・・高温過熱器、（35）・・再熱器。

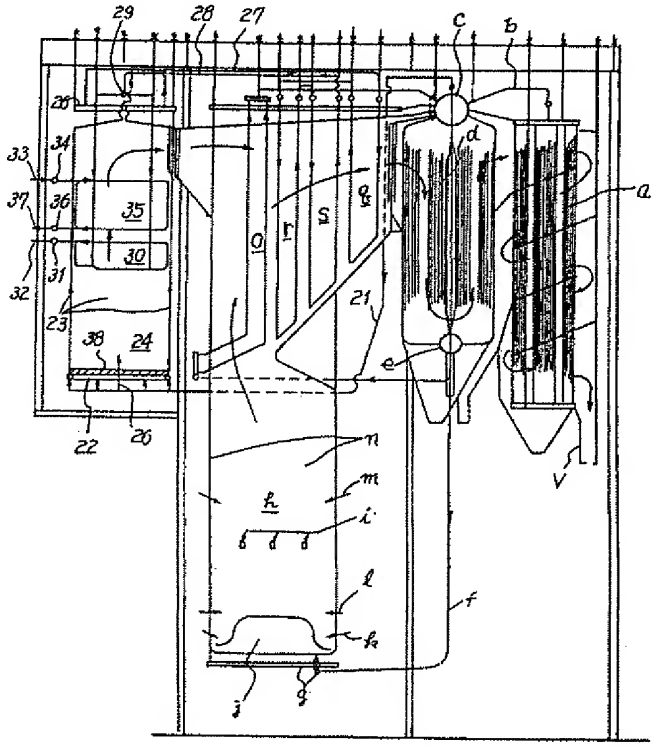
第 1 図


u
c
b
d
a
o
r
s
t
q
p
e
v
n
m
h
i
l
k
f
j
g

第 2 図


7
4
5
o
c
b
8
d
a
10
11
6
12
13
3
2
e
1
q
r
s
n
m
h
i
l
k
f
j
g
v

第 3 図


29
28
27
c
b
25
d
a
33
34
35
37
36
30
31
32
23
38
24
22
26
q
o
r
s
21
e
n
m
h
i
l
k
f
j
g
v

手続補正書(自発)

昭和58年12月9日

特許庁長官　若杉　和夫　殿

1．事件の表示　特願昭58年212583号

2．発明の名称　ソーダ回収ボイラ

3．補正をする者　事件との関係　出願人
名称　三菱重工業株式会社

4．復代理人　〒100東京都千代田区有楽町一丁目8番1号
日比谷パークビルヂング519号(電話213−0686)
(5166)　木村　正巳

5．補正の対象　明細書の「発明の詳細な説明」の欄

6．補正の内容

明細書を次のように訂正します。

(1)　第2頁第3行「多量の」を「多量に」と訂正と訂正します。

(2)　第6頁第19行「で施工」を「を施工」と訂正します。

(3)　第7頁第4行「四囲」を「四周」と訂正します。

(4)　第9頁第9行「プラントと」を「プラントの」と訂正します。

(5)　第9頁第14行「基因」を「起因」と訂正します。

TRANSLATION

Esko Aho & Co.

Japanese translation and information service
日本語翻訳 • 情報サービス

60-105802

Esko Aho 25 September 2006 1(5)

FROM Japanese unexamined patent application (kokai)
No. 60-105802 (11 June 1985)

FOR **TAMPEREEN PATENTTITOIMISTO OY**
Hermiankatu 12 B, FI-33720 TAMPERE, FINLAND

ORDER E-mail order of 14 September 2006 by
Unto Hakola

(19)	Japan Patent Office (JP)	
(12)	**UNEXAMINED PATENT APPLICATION [KOKAI TOKKYO KOHO] (A)**	
(11)	Number of publication	60-105802
(43)	Date of publication	11 June 1985

(51)	Int. Cl.^{4} (IPC)	F 22 B 1/20
	Further classification	-
	Examiner	8313-3L
	Request of examination	not yet filed
	Number of inventions	1
	(Total 5 pages)	

---

(54) Title of the invention **SODA RECOVERY BOILER**

(21) Number of application 58-212583
(22) Date of filing 14 November 1983

(72) Inventors *Urakata, Hisaryu*
c/o Mitsubishi Heavy Industries, Ltd., Nagasaki Shipyard
1-1. Awanouramachi, Nagasaki-shi, Japan

(71) Applicant **MITSUBISHI HEAVY INDUSTRIES, LTD.**
(Mitsubishi Jukogyo KK)
2-5-1, Marunouchi, Chiyoda-ku, Tokyo, Japan

(74) Agent Patent Agent Kimura, Masaoto

SPECIFICATION

1. Title of the invention

Soda recovery boiler

2. Claims

A soda recovery boiler, **characterised** in that a combustion chamber surrounded by a steam-cooled wall or a water-cooled wall formed by leading steam generated in the boiler or boiler water and isolated from the black liquor combustion gas is provided in a part of the soda recovery boiler or in a separate location, an oil burner or a gas burner is provided in this combustion chamber, a high-temperature superheater is arranged at the outlet of the combustion chamber, and by leading steam superheated by the black liquor combustion gas to this high-temperature superheater, superheated steam with a still higher temperature is produced by the combustion heat of oil or gas without the risk of causing abnormal corrosion to the superheater tubes.

3. Detailed description of the invention

This invention is related to a soda recovery boiler provided especially in paper mills.

In a soda recovery boiler provided in a paper mill, the waste liquid generated in the pulp production process, i.e. black liquor, is used as fuel, and since the said black liquor contains large amounts of chemicals used in the pulp production process, the combustion gas of the said black liquor and the ash contained in the said gas contain large amounts of corrosive constituents, they corrode boiler tubes heavily during the boiler operation. The said corrosion is the heavier the higher the temperature of the metal of the tubes is, and occurs especially heavily in the superheater tubes where the metal temperature is highest in the boiler.

A typical example of conventional soda recovery boilers where black liquor is used as fuel is explained by referring to Fig. 1, wherein the boiler supply water heated in a fuel economizer (a) is led through a fuel economizer outlet connection tube (b) to a steam drum (c), the water in the said drum descends through boiler water tubes (d) and enters into a water drum (e), then part of the water in the said water drum ascends through the said boiler water tubes and becomes a gas-water mixture, enters again into the said steam drum, and all the rest of the water is led through a descending tube (f) into a tube end (g) of the bottom part of a furnace, and while the water of the said furnace bottom tube end receives heat from the furnace (h), it ascends through a furnace evaporator tube (n) becoming a gas-water mixture, and is then led into the said steam drum.

This gas-water mixture is separated into steam and water by a gas-water separator inside the said steam drum, and only the said steam is led through a saturated steam connection tube (o) into a superheater to be described later, the steam temperature is gradually increased while it passes through a screen superheater (p), a primary superheater (q), a secondary superheater (r), a tertiary superheater (s) and a quaternary superheater (t), and from the outlet of the said quaternary superheater, the steam that has reached the set temperature is led through a main steam tube (u) into a turbine.

To explain the combustion of black liquor, the black liquor injected into the furnace by a black liquor burner (i) accumulates in the bottom part of the furnace as a char bed (j), which is burned by injecting 80-90 % of the total air from primary air nozzles (k) and tertiary air nozzles (l) into it, and by injecting the remaining 10-20 % of air from secondary air nozzles (m) above it, the uncombusted substance contained in the combustion gas is burned completely, and the high-temperature combustion gas leaving the furnace flows in the arrow direction shown in Fig. 1, and while the gas carries out heat exchange with the said screen superheater, primary superhea-

ter, secondary superheater, tertiary superheater, quaternary superheater, boiler water tubes and fuel economizer, its temperature decreases and it reaches the boiler outlet duct (v).

However, the above-described conventional soda recovery boiler has the problems that in order to suppress the said corrosion phenomenon, the steam temperature at the outlet of the superheater is limited to maximum 450-500°C, but from the recent points of view of saving resources and energy, it is strongly required to improve the efficiency of plants, and therefore the temperature and pressure of the boiler must necessarily be increased, but if the steam temperature is increased from that described above, the corrosion becomes a step more violent, and for replacing superheater tubes with a wall thickness decreased by corrosion, the boiler must be stopped frequently, which has a large adverse effect on the operation of the paper mill.

This invention is based on such present conditions, and has the objective of providing a soda recovery boiler that solves the problems of the prior boiler so that steam is heated by the black liquor combustion gas to a temperature region with no risk of corrosion, and then the said steam is further superheated into a higher temperature in a high-temperature superheater by means of combustion gases of oil or gas having a lower corrosivity than the black liquor combustion gas.

Next, an embodiment of this invention is explained by referring to the attached Fig. 2, showing a furnace (h) with an oil or gas combustion chamber (12) provided in its top part, separated by bulkhead evaporation tubes (3), i.e. a water-cooled wall with a welded wall construction, provided with a rather small-capacity oil or gas burner (6) necessary for increasing the steam temperature to the set value, a high-temperature superheater (9) being arranged at the outlet of the said combustion chamber, the steam heated to 400-500°C by the black liquor is led into it, and the said gas is heated in the said superheater to a higher set temperature, and to describe the flows of the said steam, water and combustion gas in detail, part of the boiler water is led from a water drum (e) through a distribution tube (l) into the bulkhead inlet tube end (2), and while receiving heat by passing through the bulkhead evaporator tubes (3), it ascends and becomes a gas-water mixture, enters into the bulkhead outlet tube end (y), and further through a bulkhead rising tube (5) into a steam drum (c).

After this, saturated steam is led from the said steam drum through a saturated steam connection tube (o) into a primary superheater (q), then it is successively heated by the black liquor combustion gas while passing through a secondary superheater (r) and a tertiary superheater (s), and when it has reached 400-500°C, it is led through a high-temperature superheater inlet connection tube (7) into the inlet tube end (8) of a high-temperature superheater, and after it has been heated to a still higher set temperature by the said high-temperature superheater placed in the top part of the said oil or gas combustion chamber, it goes to the high-temperature superheater outlet tube end (10) and is led through a main steam tube (11) into a turbine.

In the said oil or gas combustion chamber, combustion is carried out by injecting both fuel and air at the same time from an oil or gas burner (6), and while the combustion gas carries out heat exchange with the said bulkhead evaporator tubes and the high-temperature superheater, it flows as shown by arrows in Fig. 2 through the top part (screen part) of the said bulkhead evaporator tubes and joins the flow of the black liquor combustion gas.

Part of the water-cooled wall, consisting of the bulkhead evaporator tubes (3) and forming the said oil or gas combustion chamber, is provided with refractories (13) so that the heat absorption in this part is made small and the heat generated by the said oil or gas burner is passed as effectively as possible to the said high-temperature superheater.

Next another embodiment of this invention is explained by referring to Fig. 3, wherein an oil or gas combustion chamber (24) surrounded by steam-cooled wall tubes (23) cooled by saturated steam led from a steam drum (c) is provided, a rather small-capacity oil or gas burner (25) necessary for increasing the steam temperature is provided in the said combustion chamber, a high-

temperature superheater (30) and a reheater (35) are provided in its top part, the steam superheated to 400-500°C by the black liquor combustion is led to the said high-temperature superheater and heated further to the set higher temperature, the steam from a high-pressure turbine is again superheated by the said reheater and sent to a low-pressure turbine, and to describe the flows of the said steam and combustion gases in detail, saturated steam from a steam drum (c) is led through a saturated steam connection tube (21) into the inlet tube end (22) of a steam-cooled wall, it passes the said steam-cooled wall tubes, ascends while receiving heat and enters into the outlet tube end (26) of the steam-cooled wall, is further led through a primary superheater inlet connection tube (27) into a primary superheater (q), is then consecutively superheated by the black liquor combustion gas by passing through a secondary superheater (r) and a tertiary superheater (s), and when the steam temperature has reached 400-500°C, it is lead through a high-temperature superheater inlet connection tube (28) to the inlet tube end (29) of the high-temperature superheater, then superheated to the set higher temperature by the high-temperature superheater (30) provided in the top part of the said oil or gas combustion chamber, and then enters into the outlet tube end (31) of the high-temperature superheater and is led through a main steam tube (32) into a high-pressure turbine.

After leaving the said turbine, the steam is led through a low-temperature reheating steam tube (33) into the inlet tube end (34) of the reheater, is again superheated to a high temperature by the reheater (35), then enters into the outlet tube end (36) of the reheater and is led through a high-temperature reheated steam tube (37) into a low-pressure turbine.

Combustion is carried out in the said oil or gas combustion chamber by injecting fuel and air at the same time from an oil or gas burner (25), and while carrying out heat exchange with the said steam-cooled wall tubes, high-temperature superheater and reheater, the combustion gas flows as shown by arrows in Fig. 3, passes through the screen in the top part and joins the flow of the black liquor combustion gas.

Thus, according to this invention, steam is heated by the black liquor combustion gas until a temperature where there is no risk of corrosion, after which the said steam is led into a high-temperature superheater wherein it is further superheated to a higher temperature by the combustion gas of oil or gas having a lower corrosivity than the black liquor combustion gas, and therefore the steam temperature at the superheater outlet is increased until 540-570°C, about equal to that of a normal electric power plant, and by further providing a reheater, the efficiency of the plant can be increased considerably, and since the increasing of the steam temperature by the black liquor combustion gas is limited to a temperature region where there is no risk of corrosion, the replacement of superheater tubes due to wall thickness decreased by corrosion as in the prior art becomes practically unnecessary, the operability of the paper mill can be greatly improved etc., and thus the industrial value of this invention is extremely high.

4. Brief description of figures

Fig. 1 is a vertical cross-section view of a conventional soda recovery boiler, Fig. 2 is a vertical cross-section view of an embodiment of this invention, and Fig. 3 is a vertical cross-section view of another embodiment of this invention.

(h) – furnace, (i) – black liquor burner, (3) – bulkhead evaporator tube, (6) – oil or gas burner, (9) – high-temperature superheater, (12) – oil or gas combustion chamber, (23) – steam-cooled wall tube, (24) – oil or gas combustion chamber, (25) – oil or gas burner, (30) – high-temperature superheater, (35) – reheater.

Fig. 1

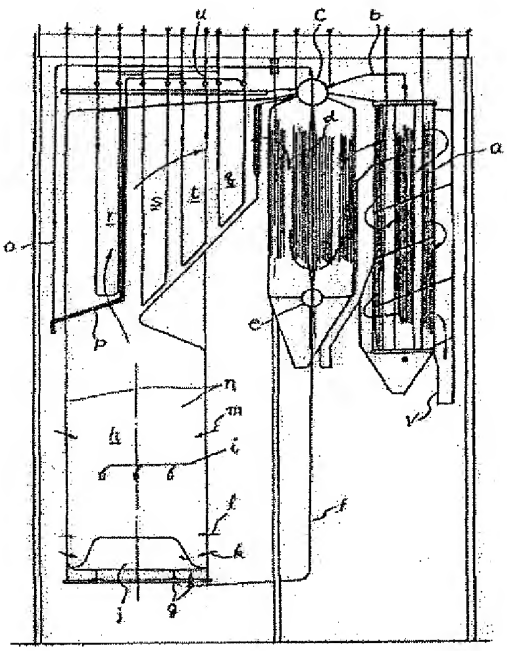


Fig. 2

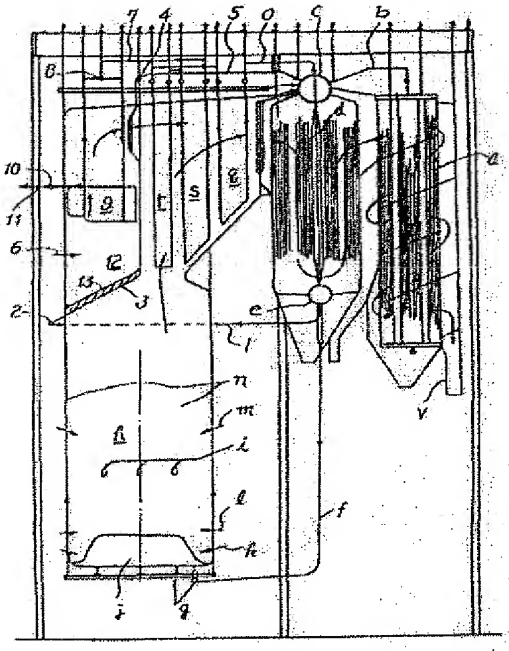


Fig. 3